



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Fabrice LETERTRE

Confirmation No.: 2583

Application No.: 10/621,358

Group Art Unit: 1765

Filing Date: July 18, 2003

Examiner: Shamim Ahmed

For: METHOD FOR PROVIDING A SMOOTH  
WAFER SURFACE

Attorney Docket No.: 4717-6800

**PRE-APPEAL BRIEF REQUEST FOR REVIEW**

**Mail Stop AF**

Commissioner for Patents

P.O. Box 1450

Alexandria, Virginia 22313-1450

Sir:

Applicants request a panel review of the decision of the Examiner mailed January 10, 2006 rejecting claims 1-14 and 16-23.

These claims 1-5 were rejected over Hashima, Hasima in view of Li, or Hashima in view of Li and Kang. The Office Action includes the argument that Hasima inherently discloses using a predetermined diamond/silica volume ratio, and that polishing is performed to obtain a smoother surface for bonding to polished surfaces.

Claim 1 is directed to a method for providing a smooth wafer surface, in which an abrasive mixture is formulated by mixing diamond particles and silica particles in a solution. The formulation is sufficient for smoothing a polar material surface, and the diamond/silica volume ratio is selected to control and obtain a desired surface roughness. Claim 21 further recites that the diamond/silica volume ratio is selected to substantially minimize the roughness of the polished surface, and claim 22 uses similar language.

As disclosed in the present application, for example in Fig. 1 and the description thereof, when a polar material such as silicon carbide is polished with a mixture of diamond and silica particles, a diamond/silica volume ratio that is either too low or too high results in a higher rms roughness that requires additional finishing. In

contrast, a diamond/silica volume ratio in a beneficial range that is disclosed and which is present as a dip in the graph provides unexpected advantages in polishing polar materials. As seen from the application, this is not a matter of mere optimization. Hasima does not provide any indication or suggestion that the diamond/silica ratio can be used to control the roughness. Instead, Hasima does not include any teaching or suggestion that can be used by one of ordinary skill in the art to control the roughness or to minimize the roughness. Thus, one of ordinary skill in the art would not find any teaching or suggestion on how to provide the claimed smoothness for a surface that was provided after a layer transfer therefrom, by polishing based on the teaching of Hasima.

Furthermore, dependent claims such as claims 6 and 7 are also certainly not taught or suggested by Hasima, and they recite the preferred range that the inventors have discovered provide the best improvement in roughness, also as disclosed in the description of Fig. 1. Claim 8 defines the preferred grain size that is also not taught or suggested in Hasima, and which the inventors have found has an important effect on the ultimate roughness. In combination with the recited ratios and particle sizes, the specifics of the polishing recited in claims 10-13 are not an obvious combination in further view of Li, since these parameters of the polishing operation can have a significant effect on the roughness that is provided and are dependent on the type of material used and the type of material polished. The present process is not in a predictable art from which one of ordinary skill in the art would merely pick and choose parameters from different polishing teachings and know that the final polishing would be improved. In fact, the solution that Hasima used was very inefficient, since it was only able to obtain a removal rate of about one atomic layer per minute. This certainly does not suggest the present invention.

The secondary references do not remedy the deficiencies of Hashima to result in the presently claimed invention. Thus, Li and Kang do not assist in rendering the present claims obvious.

In view of the above, it is believed that the Examiner's final rejection should be withdrawn as to all claims and at least as to dependent claims 6-8 and 10-13.

Respectfully submitted,

Date: 5-15-06

  
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## **LISTING OF CURRENT CLAIMS**

1. A method for providing a smooth wafer surface comprising:  
formulating an abrasive mixture by mixing diamond particles and silica particles in a solution, such that the formulation is sufficient for smoothing a polar material surface that is polished therewith, wherein the abrasive mixture has a diamond/silica volume ratio that is selected to control and obtain a desired surface roughness of the polished polar material surface;  
and  
polishing a surface of the wafer with the abrasive mixture to obtain a desired roughness that is sufficient for molecular bonding to another polished substrate face.
2. The method according to claim 1 further comprising bonding the smooth wafer surface to at least one other wafer to form a multilayer structure.
3. A method according to claim 1 wherein the wafer comprises a the polar material.
4. A method according to claim 3 wherein the material is a semiconductor material.
5. A method according to claim 4 wherein the material is silicon carbide.
6. The method according to claim 4 wherein the predetermined volume ratio is 0.29 to 0.35.
7. The method according to claim 6 wherein the predetermined volume ratio is 0.3 to 0.33.
8. The method according to claim 4 wherein the silica is a colloidal silica and the diamond particles have a grain size of between about 0.6 and 0.9  $\mu\text{m}$ .
9. A method according to claim 8 wherein the polishing is conducted with a polishing head rotating at between about 10 to 100 rpm and a polishing turntable also rotating at about 10 to 100 rpm.
10. A method according to claim 8 wherein the polishing is conducted with a polishing head rotating at between about 35 to 65 rpm and a polishing turntable also rotating at about 35 to 65 rpm.
11. A method according to claim 9 wherein the polishing head and turntable rotate at essentially the same speed.
12. A method according to claim 9 wherein the polishing head is pressed against the wafer surface with a force of about 10 to 50 daN.

13. A method according to claim 9 wherein the polishing head is pressed against the wafer surface with a force of about 7 to 15 daN.

14. A method according to claim 8 wherein the surface is provided by transferring a layer from the wafer to expose said surface, and the polishing is performed for a duration of about 30 minutes to 2 hours.

15. (Cancelled)

16. A method according to claim 5 wherein polishing is performed on at least one of the Si face of the wafer or the C face of the wafer.

17. A method according to claim 1 further comprising final cleaning to avoid crystallization of abrasive agents on the wafer surface.

18. The method of claim 1, further comprising performing an ultrafinishing polishing on the polished surface to improve the surface sufficiently for molecular bonding to another polished substrate surface.

19. The method of claim 18, wherein the ultrafinishing polishing comprises polishing the polished surface with pure colloidal silica.

20. The method of claim 1, further comprising providing the surface by transferring a layer from the wafer to expose said surface.

21. The method of claim 1, wherein the diamond/silica volume ratio is selected to substantially minimize the roughness of the polished surface.

22. A method for providing a smooth wafer surface comprising:  
formulating an abrasive mixture by mixing diamond particles and silica particles in a solution, such that the formulation is sufficient for smoothing a polar material surface that is polished with the abrasive mixture, wherein the abrasive mixture has a diamond/silica volume ratio that is selected to substantially minimize the surface roughness of the polished polar material surface;

providing a wafer surface of the polar material by detaching a layer from the wafer to expose said surface; and

polishing the wafer surface with the abrasive mixture to obtain a desired roughness that is sufficient for molecular bonding to another polished substrate surface.

23. The method of claim 22, further comprising performing an ultrafinishing polishing on the polished surface to improve the surface for molecular bonding to another polished substrate surface.